

A POSSIBLE USE FOR COIR DUST

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Introduction

The advantages of mass scale industrial production depend largely on the maximum utilization of all by-products. This is a factor which has to some extent been ignored in the coconut industry. Coir dust has been a complete waste product of the fibre milling industry for decades. Though thousands of tons are turned out annually none of it has been harnessed for industrial production. At present a small percentage of the total annual production of coir dust seems to be used occasionally by the coconut industry for its capacity to retain soil moisture and is buried or spread out on plantations during the wet season so that the absorbed moisture may be available to the plant during the dry season. Although many workers have endeavoured to utilize this by-product effectively, little headway appears to have been made up till now.

The annual accumulation of the vast amount of the by-product without adequate or economic methods of disposal, sometimes compels a miller to change the site of production. This factor itself is a sufficient indication of the nature of the problem, and the need for a quick solution.

Present Methods and Utilization

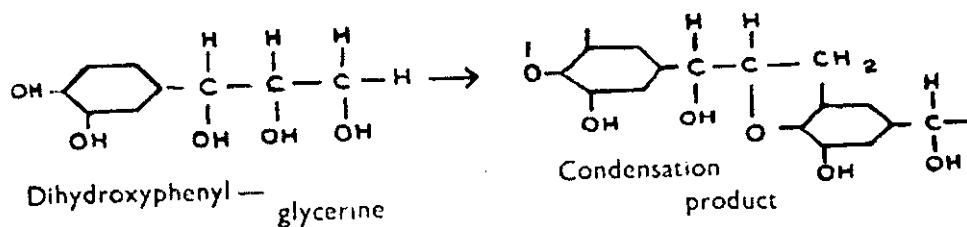
Some workers in this field have evolved a number of chemical processes and methods by which coir dust could be put into use. In Ceylon a number of patents have been registered for the manufacture of hardboard from coir dust. The writer too has been working in this field for some time and has succeeded in developing an economical process for the manufacture of moulded articles for many domestic and constructional purposes. An attempt is made in this paper to illustrate very briefly, the process evolved by the writer.

The basic principle involved in this process is the use of the lignin inherently present in coir dust (35 to 45 per cent). The following analytical figures for coir dust have been published in the Ceylon Coconut Research Scheme Bulletin (1).

Coarse Coir Dust on Air Dry Material

	Percent
Moisture	12.67
Ash	21.86
Nitrogen	0.45
Lignin	36.75
Cellulose	20.44
Pentosan/Lignin ratio	0.26
Pentosan	9.48

In nature all woods (soft and hard) are built up in a similar manner. The lignin originates in the meristematic cells and culminates in the hard and lignified dead cells. In most woods the walls of young and actively dividing cells are gradually thickened with layers of lignin and this ultimately leads to their death. These in turn are replaced by younger ones, the older ones being crushed in the process and finally a hard wood is formed. This process goes on in the development of the coconut husk and shell too. It is fortunate that coir dust contains a high percentage of this lignin which hardens all woods. The chemical nature of lignin varies from source to source. Nature seems to have used simple reactions from classical chemistry in the building up of lignin. Although its constitution is not precisely known it would appear to contain dihydroxyphenyl-glycerine which as Freudenberg (2) suggests, condenses according to the structural formula given below:—



A Suggested Reaction for the Formation of Lignin

This polymerisation should continue at length building up lignin three dimensionally, because an interlinking in all directions is possible.

Our problem of finding a use for coir dust could be easily solved if we are in a position to depolymerise the lignin in coir dust and then effect their aggregation once more in the form of one mass, thereby leading to the manufacture of moulded articles. A series of experiments were carried out by the writer with the view to bringing about this depolymerisation. The chemicals used could be classified into the following groups:

- (a) Delignifying Agents.
- (b) Oxidising Agents.
- (c) Oils.
- (d) Waxes.

As a result of these experiments it was found that the lignin present in retted and unretted coir dust could be made to form aggregate units in the presence of liquid media when subjected to simultaneous pressure and temperature. This aggregation brings about the binding of the fillers such as cellulose present in the ligneous waste. Construction materials and moulded articles could be manufactured by employing this process. Earlier workers who had the intention of utilizing ligneous waste for the manufacture of construction material, used extraneous binding media to serve their purpose. For example, it has been customary to use resins, gums and glues to manufacture hardboard and similar articles. In the manufacture of hardboard from soft wood it is the usual practice to extract the lignin present in the wood by delignification, the bonding being brought about either by interlocking of the cellulose fibrous material forming a felt or by the use of extraneous binding media. The use of the extraneous binding media entails additional cost especially when ligneous waste is used as a raw material. Moreover it is uneconomical in the present situation where the binding materials have to be imported.

Discussion

In the course of my experimental work which led to the process under discussion it was found that a certain percentage of liquid must be present in the coir dust to bring about an aggregation of the lignin units to make it act as a binding material. For the first experiment retted coir dust was dried at 65°C for 3 hours and fifty grammes of this dust was introduced into a mould 16 sq. inches in area. This was then subjected to a pressure of 16 tons at 153°C for fifteen minutes. The sample board thus obtained was weaker than a similar one produced from air dry dust subjected to the same pressure and temperature. An expansion was observed when the former sample board was removed from the frame of the mould. The thickness of the sample was 0.23 inch when it was removed from the frame but within 48 hours the thickness increased to 0.48 inch. The reversion of the sample board to coir dust was brought about when immersed in water. This clearly shows that there is no binding produced when the retted coir dust is dried at 65°C (or higher temperature) so as to reduce the percentage of moisture present far below the average air dry condition. Hence a certain percentage of water may be said to be essential if the lignin present in coir dust is to be used as a binding material.

Further experiments conducted revealed that water is not the only type of liquid medium that would bring about the aggregation of lignin units. For example retted coir dust was dried at 110°C for 2½ hours. Four ounces of this dust was mixed with 33 cc. of coconut oil and then the mixture introduced into a mould of 16 sq. inches and subjected to a pressure of 1 ton per square inch at 150°C for eight minutes. The above experiment was repeated with castor oil, linseed oil, diesel oil, paraffin wax, bees wax, glycerine, benzaldehyde, acetaldehyde, nitrobenzene, acetic acid, stearic acid etc. In all the above cases a satisfactory binding was found in the samples produced. However, liquids of higher boiling points gave better bonding than those with comparatively low boiling points. A peculiar result was obtained with carbon tetrachloride. The sample produced in this case was similar to that from dust dried at 65°C for 2½ hours and pressed with no liquid medium added. Hence the presence of CCl₄ did not bring about an aggregation of lignin units. Since all the substances which gave a satisfactory bonding could not be classified into one general group the term 'Liquid media' has been used in this paper.

About 65 per cent of the weight of the coconut husk is composed of this ligneous waste material. Other ligneous materials like coconut shell dust and saw dust could also be used provided they are mixed with coir dust in the correct proportions. It is envisaged that the present process will bring about the utilization of these waste products for the manufacture of construction materials.

Ceylon exported 802,544 tons of coir fibre in 1959. We could estimate therefore that something like 1,605,088 tons of coir dust would have accumulated in our fibre mills during that year. Considering the vast quantities of coir dust available and also the disadvantages it offers to the fibre milling industry it would prove to be an economical raw material for the manufacture of wall boards, ceiling boards and floor tiles. In the case of heavy construction materials like doors and windows a prestressed steel skeleton could be used to give additional strength. Since the finished products turned out by this process take a high polish, they will not only be economical but also attractive in appearance as well. Further, the products could be coloured in various shades and will neither shrink nor warp when subjected to the average weather conditions. They could also be sawed, nailed, drilled and glued as required for making useful articles.

References

1. Ceylon Coconut Research Scheme Bulletin, No. 3, Pl. I, p. 3 of 1938.
2. Colloid Science by H. R. Kruyt.
3. Ceylon Customs Returns, December 1959.

Acknowledgements

The writer wishes to express his sincere appreciation of assistance and advice to

1. Mr. E. C. S. Paul, Director of Industries for having afforded facilities at the Industrial Research Laboratory of the Department of Industries at the early stages of his experiments.
2. Mr. Richard Peiris and Mr. C. A. Coolman of Richard Peiris & Co., Ltd., for having allowed the use of the Company Hydraulic Presses for his experiments.
3. Mr. D. W. R. Kahawita, formerly Chief Designs and Research Engineer of the Department of Irrigation for having certain samples tested at his laboratory.
4. Prof. E. L. Fonseka, Professor of Chemistry of the University of Ceylon for giving him valuable advice on the experiments conducted.
5. Dr. M. L. M. Salgado and Mr. W. R. N. Nathanael of the Coconut Research Institute of Ceylon for having afforded facilities at the Institute Laboratories to complete the work.

(The writer will be glad to assist persons interested by making available to them specimens of various articles elaborated out of the material. The manufacture of this material was registered in Ceylon under the following Patents Nos. 4077, 4090, 1100).